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The Data Management Support of Science Projects/ Field Campaigns: The OTTER Experience

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Data Management Support of Science Projects/ Field Campaigns: The OTTER Experience

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Large earth science projects typically involve several investigators from different research and educational institutions collaborating to study similar scientific phenomena in a team environment. These projects often collect a tremendous amount of data from several different types of satellite, aircraft and ground-based instruments during coordinated field campaigns. Even more data, which are generated after data collection, are derived from the raw data or are output from models. To manage the large volume of data as it is collected and to perform several data-related services after collection, many projects employ a formal data system. The qualities that the data system must have to effectively serve the data needs of the project are many. From the experience in supporting the Oregon Transect Ecosystem Research (OTTER) project, it was learned that the ability to interact with the science project from the perspective of the project scientists and the ability to respond flexibly to unexpected changes are two very important attributes.

The OTTER project is a NASA-sponsored study with the objective of estimating major fluxes of carbon, nitrogen, and water of forest ecosystems using remotely sensed data. More than 20 scientists using 18 different instruments have collected over 14 gigabytes of satellite-, aircraft-, and ground-based data along an elevational and climatic gradient in west central Oregon. in addition, data from a simulation model and data derived from other data (such as leaf area index) are being generated.

The Pilot Land Data System is a major three-NASA-center information system charged with supporting the data requirements of the land science community. The PLDS site at the Ames Research Center has been managing data gathered by scientists of the OTTER project for the last two years. Information and documentation about the data are available to OTTER investigators via the on-line database on the PLDS/Ames computer which is accessible through major national networks and by modem. Many other services, such as data format specification and data distribution, are also provided to OTTER investigators by the PLDS staff at Ames.

In this presentation, four aspects of data management support of science projects are discussed with examples of what has worked and what has not worked in the OTTER experience. The preparation phase of project support requires a considerable amount of listening (on the part of the data system management and staff) to expected scientist data needs without encumbering scientists with confusing paperwork. The organization of the supporting data system is important in being able to respond knowledgeably to scientist requirements. A pro-active attitude displayed while interacting with investigators

is necessary in building confidence in the data system, but will not guarantee timely submission of investigator-generated data. Changes in requirements emerging from the project, data processing centers, and sponsoring agencies demand flexibility in data system management and staff and precludes an excessive amount of project support planning.

Data systems supporting science projects perform a dual role. To enable the execution of the highest quality science, the immediate needs of the science project as it is taking place must be served. At the same time, the data system must consider the data legacy of the project by ensuring that data are prepared well and verified. These roles require different attributes from data system management and staff: both flexibility and responsiveness and an awareness of the standards and needs of the scientific community. If these roles can be successfully performed, both the unique qualities of the project can be enhanced and high quality data useful in future research can be made available.

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Outline

- Background
  - OTTER
  - PLDS
  - Support of OTTER by PLDS
    - Services
    - Operations
- Support of Science Projects / Field Campaigns
  - Preparation for Project Support
  - Data System Organization
  - Scientist Interaction
  - Changes in Requirements
- Conclusions/ Recommendations

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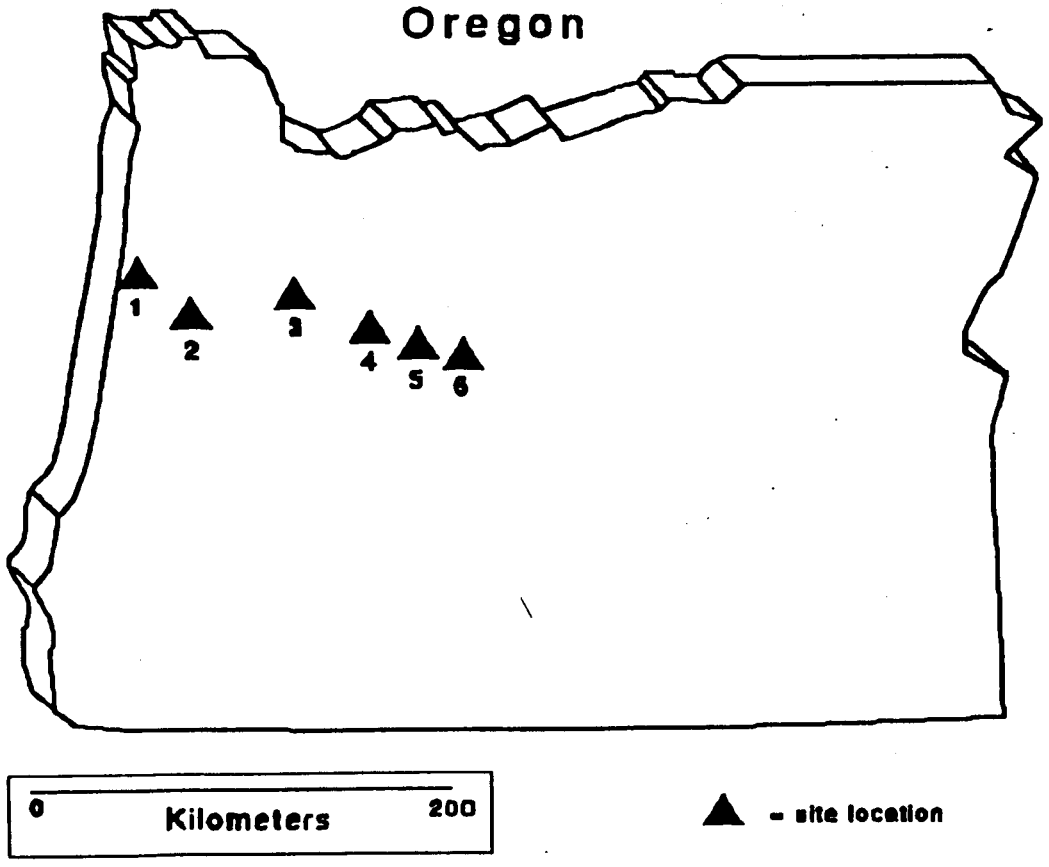
OTTER



Oregon Transect Ecosystem Research Project

* More than 20 Scientists (from USA & Canada)
* Various Ecosystem Studies
* Forest Model Testing
* Four Major Data Collection Dates (1990-1991)
* Data Types
  - Remote Sensing
  - Ground
  - Derived
  - Model
* Over 14 Gigabytes of Data

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PLDS

Pilot Land Data System

A large data and information system serving NASA-supported investigators in the earth science community

Dedicated hardware, software and staff at three sites:

- Ames Research Center (ARC)
- Goddard Space Flight Center (GSFC)
- Jet Propulsion Laboratory (JPL)

Developed data dictionary standards across all sites

Uses PLDS-developed user interface and data ordering software

Site at Ames is host to the support of the OTTER project

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PLDS Support of OTTER Major Services

- Scientist Interaction
  - Standard Format Coordination
  - Certification Scheme Development
  - Data Use Policy Development and Enforcement
  - Data and Documentation Quality Standard Enforcement
  - Personalized Assistance
- Management of a Wide Variety of Data
  - Distribution of Data and Documentation (Tape and Network)
- On-Line System
  - On-Line Inventory and Ordering of OTTER Data and Documentation
  - Documentation of On-Line Information System
  - Tracking of On-Line System Use and Data Orders
  - Access to Field Data At Oregon State University
- Publication of OTTER Data on CD-ROMs

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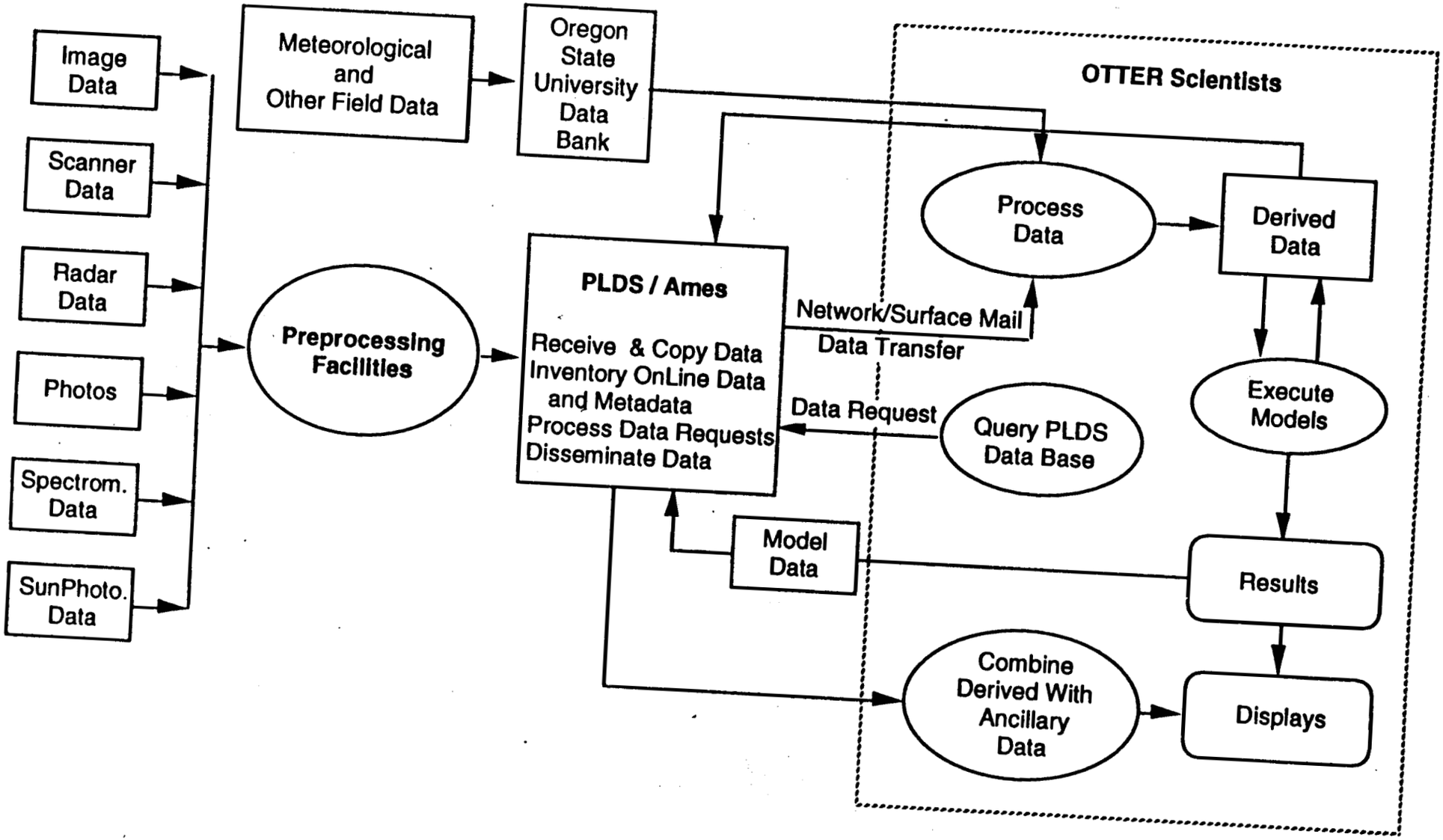
PLDS Support of OTTER Operations



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OTTER / PLDS Data Management (as of November 1, 1992)

	Entries	Megabytes	Data Collection Dates
Satellite			
AVHRR Scenes	40	131	1990
Aircraft			
Daedalus TMS Flight Lines	95	499	'88;'89; May'91
(Raw and Atmospherically Corrected)			Feb,Mar,Jun,Aug,Oct'90
AVIRIS Scenes	30	6600	89;Mar,Aug,Oct'90;May'91
Aircraft SAR Scenes	6	47	Jun'90
Airborne Sunphotometer Days	2	1.85	Aug'90
NS001 TMS Flight Runs	68	1224	Jun,Aug'90
TIMS Flight Runs	71	596	Jun,Aug'90
ASAS Tilt Angles	362	5560	Jun,Aug'90
Aerial Photography Frames	300	N/A	'88; Feb,Mar,Jun,Aug,Oct'90
Digitized Aerial Photography Frames	7	5	Jun,Aug'90
Field, Laboratory			
Field Sunphotometer Entries	414	.097	Feb,Mar,Jun,Aug,Oct'90; May'91
Spectron SE590, LICOR Spectra	512	2.5	Jun,Aug,Oct,Dec'90; May,Aug'91
Canopy Chemistry	70	.032	1989-1991
Meteorology	10	4	1989-1991
Timber Measurements	5	.009	Aug'90
Derived			
Leaf Area Index	7	.064	May'91
Forest-BGC Model Files	4	.18	1990
Total	2003	14.6 Gigabytes	

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Selected Experiences from the Support of OTTER

Four Aspects:

- Preparation for Project Support
- Data System Organization
- Scientist Interaction
- Changes in Requirements

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Preparation for Project Support

Activities

Attended OTTER Project Planning Meetings
- to determine project and individual investigator data needs (e.g., format for field spectral data)
- to introduce the concept of formal data system support (most were unfamiliar)

Wrote Proposal
- from comments of investigators and project plan (and funding realities)
- offered to investigators for review
- consulted with other data systems which have supported science projects

What Worked

Attending Project Planning Meetings
- to understand how investigators view the project and the data- so data system can make some decisions on its own without consulting scientists (e.g., PLDS/Ames selected agreeable plot designations)

Consulting with Others Who Have Supported Campaigns
- gain additional insights, ideas, and procedures for potential use

What Didn't Work

Excessive Paperwork Requests of Investigators
- requested completion of spreadsheets about investigator data use, hardware/software

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Data System Organization

Organization

Scientist on Data System Staff
- worked as liaison with OTTER scientists
- prepared documentation, sent to scientists for review
- cleared use of data by outside investigators with submitting scientist and project manager

Small Staff (3 persons devoting part time to project support)
- each had to perform the responsibilities of others at times

What Worked

Data System Scientist
- represents scientist interests better than computer specialists
  -e.g., data use policy (used as a basis of policy for another project)

Small Staff
- each person knew about most aspects of support effort and of general needs of project

What Didn't Work

Limited Staff Expertise for the Wide Variety of OTTER Data and Tasks
- e.g., field data experience re: spectrometers
  - would have helped in writing documents and coordinating certification of data
- e.g., CD-ROM experience re: artwork

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Scientist Interaction

Activities

Attended Weekly Ames and Semi-Annual OTTER Project Meetings
- presented system, formats, procedures (e.g., certification)
- listened for potential new data requirements

Maintained Pro-Active and Responsive Approach to Project Support
- took responsibility for emerging data-related issues (e.g., confusion about location of plots within a site)
- changed data system rapidly in response to scientist requests (e.g., PLDS/Ames changed from rejected field spectral data format, modified data system to accommodate spreadsheet use by investigators)

What Worked

Project Perspective
- willingness to revise procedures (e.g., provide data in "tar" format for Unix)
  - tempered by funding and time constraints (e.g., elevation data request)
- avoidance of data system jargon

Pro-Active Approach
- Active approach is appreciated by investigators, shows to them data system interest in project and service mentality (results in support for data system from scientists)

What Didn't Work

Requests for Data Submission
- some investigators were forthcoming, others made promises but never delivered

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Changes in Requirements

Emerging During the Project From ...

Project
- unexpected data sets (e.g., '89 data, TIMS, CASI)
- calculation of solar azimuth and zenith in field spectral files

Data Processing Centers
- derived from changes in processed data
  (e.g., ASAS facility provided new method of invalid data handling)

Funding Sources
- aggressive data certification procedure
- CD-ROM production

What Worked

Flexible Management and Staff
- willingness to learn and apply new management and software procedures
- willingness to adjust priorities at a moment's notice (e.g., changes in on-line system in response to ASAS invalid data handling method)

What Didn't Work

Excessive Planning
- could not schedule most data system activities
  (e.g., data receipt, changes to plans, problems that emerged)

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Conclusions/ Recommendations

Dual Role of Data Systems Supporting Science Projects

1) Data system must support immediate data needs of project (e.g., field spectral format must be shared among project investigators)
2) Data system must consider data legacy of project (e.g., certification)

Recommended Attributes of Data Systems Supporting Science Projects

Flexibility and Responsiveness

- Improves flow of useful data and information
- Enhances the unique qualities of the project

Awareness of the Scientific Community Standards and Needs

- Enables high quality, compatible data for future research